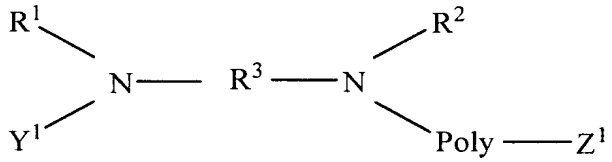
CLAIMS

1. A modified conjugated diene polymer comprising a homopolymer of a conjugated diene compound or a copolymer of a conjugated diene compound and an aromatic vinyl compound and characterized by the following formula (I):



..... (I)

(wherein R^1 and R^2 are independently an alkyl or aryl group having a carbon number of 1-20, a substituted silyl group or a hydrogen atom; R^3 is an alkylene or arylene group having a carbon number of 1-12 provided that it may include a hetero atom unless it has not an active proton; Y^1 is a substituted silyl group or a hydrogen atom; a part of R^1, R^2, R^3 and Y^1 may be bonded to each other to form a cyclic structure; Poly is a homopolymer part of a conjugated diene compound or a copolymer portion of a conjugated diene compound and an aromatic vinyl compound; Z^1 is an alkali metal or an alkaline earth metal, or a residue produced by reacting with a carbanion reactive compound, or a hydrogen atom).

2. A modified conjugated diene polymer according to claim 1, wherein R^2 in the formula (I) is an alkyl or aryl group having a carbon number of 1-20.

3. A modified conjugated diene polymer according to claim 1, wherein the conjugated diene compound is 1,3-butadiene or isoprene.

4. A modified conjugated diene polymer according to claim 1, wherein the aromatic vinyl compound is styrene.

5. A modified conjugated diene polymer according to claim 1, wherein said polymer is a copolymer of the conjugated diene compound and the aromatic vinyl compound.

6. A modified conjugated diene polymer according to claim 1, wherein said polymer has a Moony viscosity ML_{1+4} (100°C) of 10-150.

7. A modified conjugated diene polymer according to claim 1, wherein said polymer is a modified conjugated diene polymer obtained by

modifying a modified conjugated diene polymer wherein Z^1 in the formula (I) is an alkali metal or an alkaline earth metal with a carbanion reactive compound, in which Z^1 in the formula (I) is a residue produced by reacting with the carbanion reactive compound.

8. A modified conjugated diene polymer according to claim 7, wherein the carbanoin reactive compound used in the modification is a compound including at least one of C=X (X is O, S or C) and an epoxy group as a carbanion reaction site and a nitrogen-containing functional group, a silicon-containing compound, or a tin-containing compound.

9. A modified conjugated diene polymer according to claim 8, wherein the carbanion reactive compound used in the modification is at least one selected from the group consisting of 4-dimethylamino benzophenone, 4-diethylamino benzophenone, 4,4'-bis(dimethylamino) benzophenone, 4,4'-bis(diethylamino) benzophenone, 4-dimetlamino benzaldehyde, 4-diethylamino benzaldehyde, 1,1-bis(4-dimethylaminophenyl) ethylene, 1,1-bis(4-diethylaminophenyl) ethylene, 1,1-dimethoxy trimethylamine, 4-dimethylaminobenzylidene aniline, N,N-dimethylformamide, N,N-diethylformamide, N,N-dimethylacetoamide, N,N-diethylacetoamide, 4-pyridylamide, 4-pyridyl-ethyleneoxide, 4-vinylpyridine, 2-vinylpyridine, dicyclohexyl carbodiimide, ε-caprolactam, N-methyl-ε-caprolactam, 1,3-dimethyl-2-imidazolydinone, N-methylpyrolidone, pheylisocyanate, pheylthioisocyanate and diisocyanate diphenylmethane.

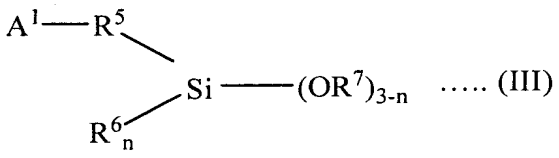
10. A modified conjugated diene polymer according to claim 8, wherein the carbanion reactive compound used in the modification is a coupling agent represented by the following formula (II):

$$R^4{}_aZ^2X^1{}_b \quad \text{..... (II)}$$

(wherein R^4 is independently selected from an alkyl group having a carbon number of 1-20, a cycloalkyl group having a carbon number of 3-20, an aryl group having a carbon number of 6-20 and an aralkyl group having a carbon number of 7-20; Z^2 is tin or silicon atom; X^1 is independently chlorine or bromine atom; and a is an integer of 0-3 and b is an integer of 1-4 provided that $a+b = 4$).

11. A modified conjugated diene polymer according to claim 8,

wherein the carbanion reactive compound used in the modification is at least one selected from the group consisting of a hdrocarbyloxysilane compound represented by the following formula (III):



..... (III)

[wherein A^1 is a monovalent group having at least one functional group selected from (thio)epoxy, (thio)isocyanate, (thio)ketone, (thio)aldehyde, imine, amide, isocyanuric acid triester, (thio)carboxylic acid hydrocarbylester, a metal salt of (thio)carboxylic acid, carboxylic anhydride, a halide of carboxylic acid, carbonic acid dihydrocarbylester, cyclic tertiary amine, non-cyclic tertiary amine, nitrile, pyridine, sulfide, multi-sulfide, an alkali metal salt of amine, al alkaline earth metal salt of amine, silazane and disilazane; R^5 is a single bond or a divalent inactive hydrocarbon group; R^6 and R^7 are independently a monovalent aliphatic hydrocarbon group having a carbon number of 1-20 or a monovalent aromatic hydrocarbon group having a carbon number of 6-18; n is an integer of 0-2; when plural OR^7s are existent, these OR^7s may be same or different; active proton and onium salt is not included in the molecule] and/or a partial condensate thereof, and a hydrocarbyloxysilane compound represented by the following formula (IV):

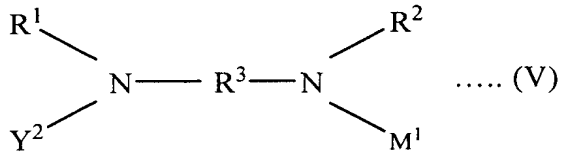
$$R^8{}_p\text{-Si-}(OR^9)_{4-p} \text{ ..... (IV)}$$

(wherein R^8 and R^9 are independently a monovalent aliphatic hydrocarbon group having a carbon number of 1-20 or a monovalent aromatic hydrocarbon group having a carbon number of 6-18; p is an integer of 0-2; when plural OR^9s are existent, these OR^9s may be same or different; active proton and onium salt is not included in the molecule) and/or a partial condensate thereof.

12. A modified conjugated diene polymer characterized by further modifying a modified conjugated diene polymer wherein Y^1 in the formula (I) is a hydrogen atom with at least one of a compound having an isocyanate group and a condensate thereof.

13. A polymerization initiator characterized by the following

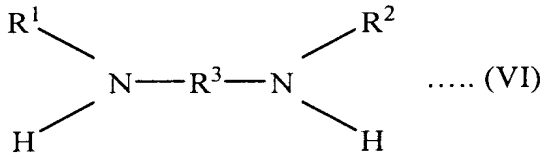
formula (V):



..... (V)

(wherein R^1, R^2 and R^3 are the same mining as mentioned above; Y^2 is a substituted silyl group; a part of R^1, R^2, R^3 and Y^2 may be bonded to each other to form a cyclic structure; M^1 is an alkali metal or an alkaline earth metal).

14. A polymerization initiator solution characterized by adding a diamine compound represented by the following formula (VI):



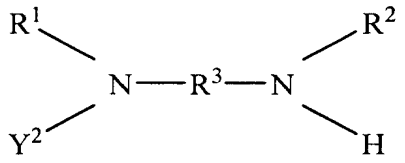
..... (VI)

(wherein R^1 and R^2 are independently an alkyl or aryl group having a carbon number of 1-20 or a hydrogen atom; R^3 is the same meaning as mentioned above; a part of R^1, R^2 and R^3 may be bonded to each other to form a cyclic structure) with a silyl compound represented by the following formula (VII):

Y^2-X^2 ..... (VII)

(wherein Y^2 is the same meaning as mentioned above; X^2 is one selected from a halogen atom, a thioalkyl group having a carbon number of 1-20, cyano group and trifluoromethylsulfonyl group) and adding an organic alkali metal compound or an organic alkaline earth metal compound thereto.

15. A method of producing a polymerization initiator, characterized in that (i) a diamine compound of the formula (VI) is added with a silyl compound of the formula (VII) to form a silylated diamine compound represented by the following formula (VIII):



..... (VIII)

(wherein R^1, R^2, R^3 and Y^2 are the same meaning as mentioned above; a part of R^1, R^2, R^3 and Y^2 may be bonded to each other to form a cyclic structure);

(ii) the said silylated diamine compound is added with an organic alkali metal compound or an organic alkaline earth metal compound to form a polymerization initiator of the formula (V).

16. A method of producing a polymerization initiator according to claim 15, wherein X^2 in the formula (VII) is a halogen atom.

17. A method of producing a modified conjugated diene polymer, characterized in that (i) the diamine compound of the formula (VI) is added with the silyl compound of the formula (VII) to form a silylated diamine compound of the formula (VIII);

(ii) the silylated diamine compound is added with the organic alkali metal compound or the organic alkaline earth metal compound to form the polymerization initiator of the formula (V); and

(iii) the polymerization initiator is used to polymerize a conjugated diene compound or polymerize a conjugated diene compound and aromatic vinyl compound.

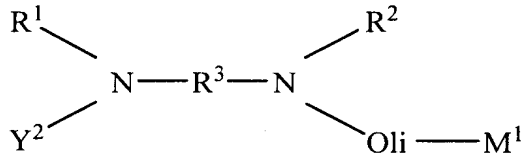
18. A modified conjugated diene polymer obtained by using a polymerization initiator solution as claimed in claim 14 and polymerizing a conjugated diene compound or a conjugated diene compound and an aromatic vinyl compound.

19. A method of producing a modified conjugated diene polymer, characterized in that (i) the diamine compound of the formula (VI) is added with the silyl compound of the formula (VII) to form a silylated diamine compound of the formula (VIII);

(ii) the silylated diamine compound is added with the organic alkali metal compound or the organic alkaline earth metal compound to form the polymerization initiator of the formula (V);

(iii) the polymerization initiator is added to a solution containing a

conjugated diene compound to produce a low molecular weight polymer represented by the following formula (IX):



..... (IX)

(wherein R^1, R^2, R^3, Y^2 and M^1 are the same meaning as mentioned above; a part of R^1, R^2, R^3 nd Y^2 may be bonded to each other to form a cyclic structure; Oil is an oligomer or polymer portion formed by polymerizing 3-300 conjugated diene compounds); and

(iv) the low molecular weight polymer is added to a solution containing a conjugated diene compound or a solution containing a conjugated diene compound and an aromatic vinyl compound.

20. A method of producing a modified conjugated diene polymer, characterized in that (i) the diamine compound of the formula (VI) is added with the silyl compound of the formula (VII) to form a silylated diamine compound of the formula (VIII);

(ii) the silylated diamine compound is added to a solution containing a conjugated diene compound or a solution containing a conjugated diene compound and an aromatic vinyl compound; and

(iii) the said solution is further added with an organic alkali metal compound or an organic alkaline earth metal compound.

21. A rubber composition characterized by including a modified conjugated diene polymer as claimed in any one of claims 1 to 12 and 18 as a rubber component.

22. A rubber composition according to claim 21, wherein a content of the modified conjugated diene polymer is not less than 10% by mass in the rubber component.

23. A rubber composition according to claim 21, which is sulfur-crosslinking.

24. A rubber composition according to claim 21, which is

compounded with 10-100 parts by mass in total of carbon black and/or an inorganic filler per 100 parts by mass of the rubber component.

25. A rubber composition according to claim 24, wherein 10-100 parts by mass of silica as the inorganic filler is compounded per 100 parts by mass of the rubber component.